



## Technical Field

## Prior Art

In recent years, digital television broadcasting is developing for broadcasting various programs such as videos, music, games, computer data, and the like to many users by means of cable broadcasting, satellite broadcasting, ground waves, and the like.

Using this digital television broadcasting, a user need not purchase or rent recording media such as optical disks, magnetic tapes, and the like which store programs such as movies, music, games, computer data, and the like. It is possible to eliminate inconvenience of acquiring such programs.

In this digital broadcasting system, however, a broadcasting station unilaterally selects time slots and contents of programs to be broadcast. Users cannot select time slots and contents of programs they wish at their discretion.

The user needs to enjoy a desired program at a convenient time slot using a time-shift feature, a library feature, and the like provided by a videotape recorder.





information expressed with these vectors, the above-mentioned selection means for the reception apparatus performs an inner product operation between the attribute information's vector A and the selection information's vector S. Based on an inner product operation result, the system determines whether to select the digital contents.

A reception apparatus according to the present invention comprises: reception means for receiving said digital content and attribute information broadcast from a broadcasting station; recording medium for recording received digital content and attribute information; output means for outputting received digital content; and selection means for selecting a digital content by comparing selection information indicating user's taste with attribute information attached to the digital content, wherein said attribute information is expressed with an n-dimensional vector A comprising attribute items as elements each indicative of attribute intensities for a digital content; said selection information is expressed with an n-dimensional vector S comprising user's taste items as elements each indicative of taste intensities; item types and orders for said attribute information and said selection information correspond to those for an attribute information's vector A and a selection information's vector S; and said selection means performs an inner product operation between an attribute information's vector A attached to a broadcast digital content and a selection information's vector S and determines whether to select that digital content based on an inner product operation result.

The reception apparatus receives digital contents provided with the attribute information. Based on this attribute information and selection information indicating users's taste, the system selects digital contents matching the users's taste from the broadcast digital contents. The reception apparatus allows users to record selected digital contents on storage media and replay them or to replay recorded digital contents according to the users's taste.

The above-mentioned attribute information is expressed with an  $n$ -dimensional vector  $A$ . This vector comprises elements each of which represents intensity of an attribute for each item when digital content attributes are categorized into items. The above-mentioned selection information is expressed with an  $n$ -dimensional vector  $S$ . This vector comprises elements each of which represents intensity of a taste for each item when users's tastes are categorized into items. The attribute information and the selection information contain item types and orders so defined that these item types and orders correspond to each other for the attribute information vector  $A$  and the selection information vector  $S$ . Based on the attribute information and the selection information expressed with these vectors, the selection means for the reception apparatus performs an inner product operation between the attribute information's vector  $A$  and the selection information's vector  $S$ . Based on an inner product operation result, the system determines whether to select the digital contents.

The broadcasting system and the reception apparatus according to the present invention provide digital contents to be broadcast with the corresponding attribute



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An embodiment of the present invention will be described in further detail with reference to the accompanying drawing.

A digital broadcasting system 1 according to the embodiment of the present invention comprises a broadcasting station 2, a reception apparatus 3, a monitor 4 connected to the reception apparatus 3, and an external storage unit 5.

The reception apparatus 3 comprises an antenna 10, a tuner 11, a filter 12, a decryption unit 13, a recording and reproduction unit 14, a recording and reproduction medium 15, a decoder 16, a controller 17, a user interface unit 18, and a modem 19.

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filter 12. In this case, the user can easily select information during a time-shift operation by displaying the title information indicating that program in a state differing from the other programs.

When the apparatus starts for use, predetermined GUI choices are placed in the selection information defined for the filter 12. Alternatively, a user specifies any available parameter values for the selection information. The selection information specified for the filter 12 may be modified as needed.

The selection information defined for the filter 12 may be changed for recording and reproduction. For example, there is the case where the selection information is provided for the number of members of the family to record received programs. In this case, the selection information is specified by OR'ing between a plurality of pieces of the selection information. The apparatus records only a program provided with attribute information matching the OR'ed selection information. When recorded programs are reproduced, the apparatus checks the selection information specified for one user and the attribute information about the programs recorded in the recording and reproduction medium 15. Based on these two types of information, the apparatus reproduces a program which matches that user's taste.

The controller 17 computes the attribute information about programs replayed by users after startup of the apparatus and analyzes each user's taste. Based on an analysis result, the controller 17 modifies a weight of each parameter value for the









### Attribute items

Movie → 8

Drama → 0

Sports → 0

Artistic → -4

Musical → -3

Dramatic → 1

Horror → 2

Amusing → 5

Specifically, the n-dimensional selection vector A is expressed as equation (2) below.

$$S = (s_1, s_2, s_3, \dots, s_n) \dots (2)$$

In this equation,  $s_1$  through  $s_n$  are elements of the selection vector S and indicate intensities of attribute attributes indicating the user's taste. The order of attribute items and the number of these items (n) in the selection vector S are same as those for elements in the attribute vector. This selection vector S is defined for the filter 12 in the reception apparatus 3.

The selection vector S indicating the user's taste is generated, say, by averaging a plurality of programs reproduced by the user. For example, it is assumed that the

user selected 50 replayed programs. In this case, the selection vector S can be generated for each selected program by averaging attribute vectors A1 through A50.

$$A_1 = (5, 2, 1, -3, -4, \dots, 0, 0, 8)$$

$$A_2 = (3, 3, 5, 1, 0, \dots, 0, 0, 8)$$

$$A_3 = (1, 2, 3, -1, 3, \dots, 0, 8, 0)$$

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$$A_{50} = (2, 3, 4, -1, 3, \dots, 8, 0, 0)$$

$$S = \frac{1}{50} \sum_{k=1}^{50} A_k = (2.1, 3.2, -1.1, 0.5, -4, \dots, 0.1, 0.3, 0.2)$$

When the number of programs to be selected is assumed to be M, the selection vector S is found in equation (3) as follows.

$$S = \frac{1}{M} \sum_{k=1}^M A_k \quad \dots (3)$$

It is assumed that the k-th program selected by the user will have the attribute vector A as follows.

$$A_k = (a_{1k}, a_{2k}, a_{3k}, \dots, a_{nk})$$

The following equation may be used to find the selection vector S by restricting the number of programs used for finding this selection vector out of a plurality of reproduced programs.

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$$\mathbf{A}_k = (a_{1k}, a_{2k}, a_{3k}, \dots, a_{nk})$$
$$S = PS_P + RS_R$$

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The following describes how to select broadcast programs.

$$A = (3, 1.1, 4, -1, 2.5, \dots, 0, 0, 8) \dots (4)$$
$$P = \frac{A \cdot S}{|A| \cdot |S|} = \frac{3 \cdot 2.3 + 1.1 \cdot 3.2 \cdot 4 \cdot (-1.1) + \dots + 8 \cdot 0.2}{\sqrt{3^2 + 1.1^2 + 4^2 + \dots + 8^2} \cdot \sqrt{2.3^2 + 3.2^2 + (-1.1)^2 + \dots + 0.2^2}} \quad \dots (5)$$

The meaning of the selection value P is described below.

[illegible]

where  $A \cdot S$  is an internal product between  $A$  and  $S$ .

$$\therefore \cos \theta = \frac{A \cdot S}{|A| |S|} \quad \dots (7)$$

When the attribute vector  $A$  and the selection vector  $S$  indicate the same direction, the result is  $P > 0$  (case 1). When the attribute vector  $A$  crosses the selection vector  $S$ , the result is  $P = 0$  (case 2). When the attribute vector  $A$  and the selection vector  $S$  are directed opposite to each other, the result is  $P < 0$  (case 3).

In case 1, the user is assumed to be interested in the program or have the similar taste. This tendency is assumed to be stronger as the value approaches the maximum value of 1.

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